REMARKS

Review and reconsideration on the merits are requested.

Claims 1-10 were pending.

The prior art: U.S. Patent 6,401,799 Arai et al (Arai); East German Patent 266,046 Balin et al (Balin), Abstract only; U.S. Patent 4,676,298 Liebermann (Liebermann); U.S. Patent 6,299,989 DeCristofaro et al (DeCristofaro); U.S. Patent 5,611,871 Yoshizawa et al (Yoshizawa '871); U.S. Patent 5,966,064 Yoshizawa et al (Yoshizawa '064).

The rejections are now discussed with a presentation of Applicants' traversal. The Examiner's position is set forth in the Action and will not be repeated here except as necessary to an understanding of Applicants' traversal of the rejections.

Claims 1 and 3-9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Arai in view of Balin. Paragraph 2 of the Action.

Claim 2 is rejected on the same grounds over Arai in view of Balin and further in view of Liebermann or DeCristofaro. Paragraph 3 of the Action.

Claim 10 is rejected on the same grounds over Arai in view of Balin or over that combination of references in view of Yoshizawa '871 or Yoshizawa '064. Paragraph 4 of the Action.

In traversing the above rejections, Applicants limit claim 1 by inserting the phrase so as to keep an average surface roughness Ra of 0.5 μm or less and a 10-point average surface roughness Rz of 4 μm or less during the casting when the surface roughness of said cooling roll is measured according to JIS B 0601. Support occurs at page 9, lines 6-12 of the specification.

Applicants first address the rejection of claims 1 and 3-9 over Arai in view of Balin.

Since the main features of the present invention are recited in claim 1 as now amended (claim 1), the patentability of claim 1 is discussed at this point.

The Examiner is requested to refer to claim 1 at this point and note the limits regarding grinding of the cooling roll during casting to keep a defined average surface roughness Ra and a 10 point average surface roughness Rz.

It is commonly known that a gas based on CO_2 (a CO_2 gas) has the ability to suppress the formation of air pockets in a paddle of an alloy melt during casting. The Inventors confirmed that although the supply of a CO_2 gas is effective to suppress the formation of air pockets, when the total length of an amorphous alloy ribbon exceeding 3,000 m is continuously produced in one casting step, there arose new problems such as a serrated irregular shape developing in edge portions in addition to embrittlement and crystallization in the amorphous alloy ribbon as the casting time passed. These "new" problems did not occur unless a CO_2 gas was supplied (see page 3 line 25 to page 4, line 8 of the specification)_

The invention in claim 1 is to provide a method to solve the "new" problems mentioned above by carrying out the grinding of the cooling roll during the casting to have it keep an average surface roughness Ra of 0.5 μm or less and a ten-point average surface roughness Rz of 4 μm or less when the surface roughness of the cooling roll is measured according to JIS B 0601 (see page 8, line 17 to page 9, line 12 of the specification).

The invention was reached based on the finding that the deterioration of surface roughness of the cooling roll due to dents caused by incessant impingement by a high-

temperature melt makes a gas highly likely to be entrained into a paddle by rotation of the cooling roll in the presence of a CO_2 gas, resulting in embrittlement and crystallization in the ribbon together with a serrated irregular shape in edge portions thereof (see page 9, line 22 to page 10, line 12 of the specification).

Arai discloses a method of manufacturing a ribbon-shaped magnet material by discharging a molten metal of the magnet material from a nozzle while rotating a cooling roll having a surface layer composed of ceramics on its outer periphery. The molten metal collides with the surface of the cooling roll and is solidified by cooling (see column 1, lines 58-65).

However, Arai merely teaches grinding the peripheral surface prior to the manufacture of the melt spun ribbon in order to obtain an appropriate surface roughness (see column 8, lines 30-33) and it is silent regarding any supply of a gas based on CO_2 during casting, i.e., Arai is unaware or ignores any phenomenon including embrittlement and crystallization in the formed amorphous alloy ribbon during the casting process.

In contrast to Arai, in the present invention grinding of the cooling roll is carried out during the casting process while supplying a gas based on CO_2 to solve the "new" problems which arose due to a combination of increased cooling roll deterioration with respect to surface roughness after a long period of casting with a gas based on CO_2.

Therefore, one skilled in the art referring to Arai, which is silent regarding not only grinding of the rolling roll during the casting but also supply of a gas based on CO_2, together with the "new" problems encountered during grinding of the rolling roll earlier mentioned,

would not reach the invention of claim 1, and, accordingly, claim 1 of the present application is not obvious over Arai.

However, the rejection is a combination rejection, and Applicants now turn to Balin.

Balin discloses a method for producing metal ribbons by rapid solidification of an alloy melt blow ejected from a nozzle onto a cooling roll surface, where a melt puddle formed at an impingement point is sprayed with an inert gas, characterized in that said melt puddle is completely sprayed with carbon dioxide (see claim of Balin).

Although Balin teaches an effect in decreasing the formation of a "lift-off" region by the use of a CO_2 gas (see page 2, lines 13-14), Balin is silent regarding the "new" problems which arise when casting is carried out for a long period of time while supplying a CO_2, and fails to teach or suggest grinding of the rolling roll during casting.

Thus, quite clearly, one of ordinary skill in the art referring to Balin, which ignores both the "new" problems and does not involve grinding of the roll as explained above, would not see a cure of the defects of Arai and, accordingly, Applicants respectfully submit that claim 1 of the present application is not obvious over Arai alone, Balin alone or Arai in view of Balin.

Certainly when one appreciates the fact that claim 1 now calls for a specified average surface roughness Ra and a specified 10-point average surface roughness Rz, quite clearly the subject matter of claim 1 is not suggested by the combination of Arai and Balin.

Applicants submit that claims 3-6 and 8, dependent from claim 1, and claim 7, dependent from claim 6, are clearly patentable over the combination of Arai/Balin in light of the above discussion.

Referring now to claim 9, claim 9 in paraphrased form calls for:

A method for producing an amorphous alloy ribbon by ejecting the same onto a cooling roll and rapidly quenching, comprising:

(a) preparing an alloy melt composition having a defined composition;

(b) ejecting the alloy melt at a defined temperature range through a nozzle onto the cooling roll rotating at a defined peripheral speed, with a defined distance between the tip end of the nozzle and the cooling roll;

(c) starting to supply a gas based on CO_2 to the alloy melt after the surface temperature of the cooling roll is substantially constant; and

(d) grinding the cooling roll while supplying the gas based on CO_2.

The Examiner is requested to note the compositional, temperature, peripheral speed and tip end/cooling roll limits set forth in claim 9.

To briefly emphasize other factors in claim 9, the invention defined in claim 9 also requires as necessary conditions based on the findings of the Inventors:

(1) supply of a gas based on CO_2;

(2) grinding a cooling roll;

(3) starting to supply the gas based on CO_2 to the alloy melt after the surface temperature of the cooling roll has become substantially constant.

All of these factors must simultaneously be met in claim 9.

The invention above was reached based on the finding such that the supply of a gas based on CO2 to a paddle immediately after the art of casting causes the ribbon to break at the initial

stage of casting (see page 15, line 19 to page 16, line 5 of the specification). Balin is silent on this point.

Therefore, one skilled in the art referring to Arai and Balin would not reach the invention recited in claim 9, and, accordingly, claim 9 is not obvious over Arai even if combined with Balin.

Withdrawal is requested.

Applicants now address the rejection of claim 2 based on Arai in view of Balin further in view of Liebermann or DeCristofaro.

Claim 2 calls for:

"The method for producing an amorphous alloy ribbon according to claim 1, wherein the grinding of said cooling roll is carried out with a brush."

It should be clear from the earlier discussion, the subject matter of claim 1 is clearly not obvious over Arai in view of Balin. However, Applicants turn to the use of a brush which the Examiner urges is suggested in the grinding of a cooling roll by Liebermann and DeCristofaro.

Liebermann discloses a method for casting metal strip, comprising the steps of:

(a) moving a chilled body having a quench surface at a selected speed;

(b) depositing a stream of molten metal on a quenching region of the quench surface to form the metal strip;

(c) supplying a gas to a depletion region located adjacent to and upstream of the quenching region;

(d) heating the gas to lower the density thereof and produce within the depletion region a low density atmosphere having a temperature of at least about 800K; and

(e) heating the quench surface to a temperature of at least about 323K, whereby precipitation of condensed solidified constituents from the atmosphere onto the depletion region and the formation of pockets in the strip are substantially prevented (see claim 1).

Liebermann thus teaches a process for producing a rapidly solidified continuous metal strip within a low density atmosphere provided by supplying a reducing gas heated to a temperature of at least about 800K capable of causing a chemical reduction reaction and heating of quench surface, thereby making it possible to obtain a very thin or thick strip having minimized gas pockets, a smooth surface and uniform physical properties (see claims 13-15: column 3, line 61 to column 4, line 14, column 6, lines 62-68, column 7, lines 1-68, column 8, lines 21-31 and column 9, lines 10-36).

In contrast to Liebermann, the method of claim 1 comprises grinding the cooling roll while supplying a gas based on CO_2, not a heated reducing gas, near a paddle of the alloy melt ejected onto the cooling roll, quite different from Liebermann in basic features.

The present application teaches a method to solve problems due to the use of a CO_2 gas having a higher specific gravity than air, nitrogen, etc., when using a gas based on CO_2 (see page 11, line 19 to page 12, line 10 of the specification), while Liebermann teaches a depletion region with a low density atmosphere obtained by heating a reducing gas such as CO, etc., having a smaller specific gravity than CO_2, thereby ignoring not only the "new" problems but also the

influence of surface roughness such as dents of the cooling roll, which increase as casting time increases during the casting process while supplying CO_2.

Further, the method in claim 1 requires control of the average surface roughness of the cooling roll below a specified value, while Liebermann teaches the use of a wiper brush, which conditions a quench surface to help reduce oxidation thereon, without explaining how its action on the cooling roll surface improves surface roughness (column 7, lines 33-34). Considering the recitation in Examples stating that:

> "The combined actions of the flame and the conditioning brush reduced the substrate oxidation, increased adhesion and produced ribbon having good geometric uniformity (see column 10, lines 33-36),"

the direct action of the wiper brush of Liebermann is clearly different from the present invention where grinding of the cooling surface to control the average surface roughness thereof below a specified value is required.

Accordingly, Applicants submit that one of ordinary skill in the art, referring to Liebermann, which is quite different from not only the present invention but Arai and Balin in basic features and is completely silent regarding the effect of grinding a cooling roll surface, would in no fashion be led to modify Arai/Balin to reach the subject matter of claim 2.

DeCristofaro teaches producing an amorphous metal ribbon with a highly smooth ribbon surface and a highly uniform thickness over ribbon width using a single roller, single shot process, where a casting wheel is used to grind and polish to achieve a surface roughness of Ra< 5 μm by the continuous application of an abrasive material with a very fine particle size, less

than about 60 μm (though Example 1 teaches less than 150 μm) in mean particle size during the casting process. DeCristofaro uses a protective atmosphere of a reducing gas to minimize reaction between the molten metal and the casting wheel (see column 2, lines 31-40, column 2, lines 60-66, column 3, lines 6-10 and column 3, lines 55-64 (Example 1)).

In contrast to DeCristofaro, the essential feature recited in claim 1 of the present application does not lie in maintaining the surface roughness of the casting roll surface of Ra< 5 μm, rather, the invention of claim 1 involves the necessity of having the casting roll maintain an average surface roughness Ra of 0.5 μm or less and a ten-point average surface roughness Rz of 4 μm or less when measured according to JIS B0601. Such maintenance permits control not only of embrittlement and crystallization in the formed amorphous alloy ribbon but also the serrated irregular shape formed in edge portions thereof (see page 12, line 16 to page 13, line 8 of the specification).

Therefore, one skilled in the art referring to DeCristofaro, which only discloses the necessity of a casting wheel to achieve a surface roughness of Ra< 5 μm (as large as 10 times the surface roughness of the present invention) would fail to see any teaching or suggestion of the use of a gas based on CO_2, and would see DeCristofaro ignores the problems which arise in the case of supplying or utilizing CO_2 as a protective atmosphere for a casting wheel surface, and thus would not be motivated to reach amended claim 1, or claim 2, and, accordingly, amended claim 1 or claim 2 of the present application is not obvious over DeCristofaro.

Thus, Applicants respectfully submit that even if combined with Arai and Balin, neither Liebermann nor DeCristofaro render the subject matter of claim 2 obvious.

Applicants now address the rejection of claim 10 based on Arai in view of Balin or over such combination of references in view of Yoshizawa '871 or Yoshizawa '064.

Since Applicants respectfully submit that claim 1 is not obvious over the earlier relied upon references, claim 10 which depends from claim 1 cannot be rendered obvious by the further teaching of Yoshizawa '871 or Yoshizawa '064, each of which simply recite a method for producing a nanocrystalline alloy by subjecting an amorphous alloy which has been produced by quenching a molten alloy to heat treating.

Withdrawal of all rejections is requested.

New prior art reference

During the examination of Japanese Patent Application No. 2001-105374 filed with the JPO based on the same Japanese Patent Application No. 2001-36999 as the present application, Japanese Patent Laid-Open No. 9-253804 (JP '804) was cited as prior art. A copy of this reference is enclosed herewith together with English abstract and an abridged English translation thereof.

The present application is not anticipated by or obvious over JP 9-253804 (JP '804) for the following reasons.

JP' 804 teaches in an apparatus for producing a metallic thin strip by the use of a cooling roll while blowing an inert gas such as Ar, He, and the like, or a CO_2 gas, into a paddle, and removing matter sticking to the cooling roll surface by a brush roll (see English translation of paragraph Nos. [0010] and [0026] of JP '804 attached hereto). The blowing of the inert gas or a CO_2 gas makes it possible to clean the surface of the metallic thin strip (see English translation

of paragraph Nos. [0026] of JP '804 attached hereto). However, JP '804 is completely silent regarding the "new" problems which arise by supplying a gas based on CO_2 discussed in the specification of the present application. Since the "new" problems are caused by the physical properties of CO_2 (see page 11, line 19 to page 12, line 10 of the specification), it would seem that they might not arise in the Examples of JP '804 involving supplying Ar gas.

In addition, JP '804 principally discloses technology to control the entrance of foreign material into a paddle, and it teaches that contaminants such as fine build-ups and oxides, etc., sticking on the roll surface can be removed by contacting the roll surface with a brush roll positioned on the up-stream side of the nozzle (see English translation of paragraph Nos. [0009], [0010] and [0021] of JP '804 attached hereto).

In contrast to JP '804, per the present invention grinding of the cooling roll is directed not only to remove material sticking to the cooling roll surface but also to smooth dents on the cooling roll surface caused by incessant impingement by a high-temperature melt to ensure the cooling roll keeps an average surface roughness Ra of 0.5 μm or less and a ten-point average surface roughness Rz of 4 μm or less when measured according to JIS 0601, even after extended casting. In this regard, the brush roll of JP '804 is used merely for removing the adherent material and is clearly different from the brush disclosed in the present application used for grinding or smoothing dents of the cooling roll surface with respect to the strength of the brush material, the arrangement of the brush members, the pressure of the brush against the cooling roll, the structure of the brush, etc. (see page 12, line 16 to page 13, line 8 of the specification).

JP '804, is silent regarding the "new" problems which arise when extended casting is carried out while supplying a gas based on CO_2, and fails to teach or suggest not only smoothing of the cooling roll surface by grinding but also the effect of the grinding while supplying a gas based on CO_2, which are the most important features of the present invention. Thus one of ordinary skill in the art would not be led to the present invention and, accordingly, Applicants submit that the present invention would not be considered by one of ordinary skill in the art as obvious over JP '804.

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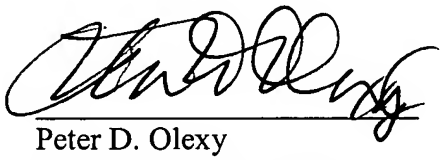
Respectfully submitted,



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